

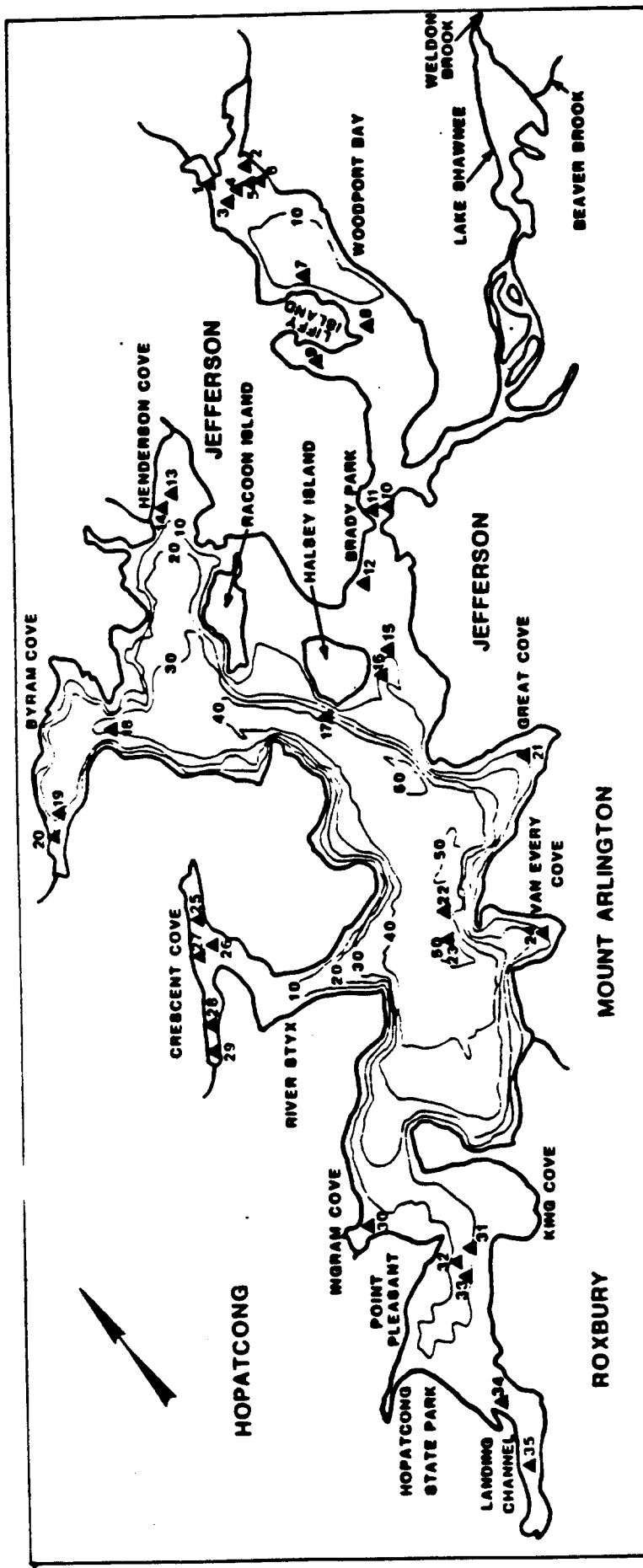
E. SEDIMENT CORE ANALYSIS

Lake sediment samples were collected from thirty-five locations within the lake (Figure 22) on four sampling dates between May and December of 1982. These sites are in the proximity of marinas, major sources of surface runoff, areas of possible future dredging activities, and in restricted coves with limited flushing capabilities.

The sediments were sampled by means of a K-B freefall brass sediment core sampler fitted with plastic (cellulose acetate butyrate) core tubes. The core samples were returned to the laboratory and frozen for preservation and for ease of handling.

Penetration of the sediment core sampler varied with the firmness of the substrate. The cores collected ranged in depth from approximately 25 to 50 cm below the mud-water interface. Subsamples of approximately 3 cm in depth were taken from the top, middle, and bottom portions of the cores for chemical and physical analyses (Table 42). In addition, the sub-samples from four of the cores were composited and analyzed using EP toxicity test procedures (Federal Register, 1980). Grain size analysis was also performed (Folk, 1968). The results of these analyses are included in Table 43.

With few exceptions, the data indicate the presence of higher levels of the measured metals in the upper strata of the cores than in the middle and lower strata. Since the sediments in the upper strata of the cores are those most recently deposited, it can be assumed that these metals have been deposited in increasingly greater amounts in "recent" years. The exact time period of this deposition cannot be stated without performing sophisticated dating analyses on the sediments but the



LEGEND

▲ SEDIMENT CORE



DEPTHS IN FEET

LAKE HOPATCONG REGIONAL PLANNING BOARD LAKE RESTORATION AND MANAGEMENT STUDY

FIGURE 22
LAKE HOPATCONG SEDIMENT CORE
SAMPLING SITE

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Table 42

LAKE HOPATCONG SEDIMENT CORE ANALYSIS
(mg kg⁻¹ dry weight except where noted)

Station*	Parameters					Depth of Sample in Inches	REDOX m volts
	Pb	Al	Fe	Zn	Hg	Cd	
1. top middle bottom	126	22,200	51,200	381	0.097	1.36	-125
	181	23,500	43,600	418	0.094	1.32	
	54.7	26,800	26,600	256	0.101	0.677	
2. top middle bottom	314	17,400	21,500	889	0.267	3.70	-105
	129	10,500	19,000	627	0.199	3.04	
	9.99	3,160	6,660	163	0.177	2.39	
3. top middle bottom	168	17,800	19,600	586	0.302	3.66	
	7.61	16,300	9,420	126	0.229	1.38	
	5.28	12,500	6,830	115	0.238	1.78	
4. top middle bottom	105	23,000	16,500	832	0.219	2.66	
	104	26,600	17,000	967	0.243	2.39	
	15.5	26,000	9,740	544	0.279	1.30	
5. top middle bottom	71.6	23,500	17,100	609	0.258	2.05	
	89.1	19,100	13,300	594	0.253	2.73	
	7.32	14,900	8,510	174	0.188	1.33	
6. top middle bottom	156	12,300	15,500	556	0.440	2.35	
	74.8	15,200	15,800	825	0.315	2.72	
	53.9	15,800	13,400	396	0.185	1.68	
8. top middle bottom	101	7,610	11,600	246	0.198	1.87	
	279	17,200	23,800	585	0.212	3.42	
	70.4	6,430	7,470	241	0.067	1.24	
9. top middle bottom	171	7,370	16,400	355	0.372	2.21	-40
	97.2	4,380	11,000	199	0.246	1.25	
	6.92	1,190	4,630	27.7	0.209	<0.837	

Table 42 (continued)

Station*	Parameters						Depth of Sample in Inches	REDOX m volts
	Pb	Al	Fe	Zn	Hg	Cd		
10. top middle bottom	140 139 29.2	19,000 15,400 14,000	29,900 21,000 13,700	762 529 202	0.358 0.157 0.246	2.88 1.78 <0.484	1 6.5 12.5	-105
11. top middle bottom	197 72.8 13.6	10,500 11,600 1,980	24,500 18,400 9,560	487 299 56.5	0.080 0.168 0.105	2.20 1.07 0.609	1 5.5 11.5	-100
12. top bottom	70.0 4.01	6,850 4,100	8,030 4,150	185 16.4	0.073 0.017	1.69 <0.142	1 9	+5
13. top middle bottom	469 58.4 13.0	8,970 5,620 2,510	37,600 15,400 7,760	1,730 172 51.9	<0.066 0.082 0.505	5.35 <1.41 <1.12	1 6.5 12	-105
14. top middle bottom	684 175 10.5	10,200 9,340 10,400	33,100 20,500 9,850	2,300 782 131	0.357 0.263 0.087	10.2 5.06 0.670	1 6.5 12	-100
15. top middle bottom	32.0 5.30 3.65	4,280 10,600 3,860	6,680 6,350 5,370	118 42.2 18.9	0.036 0.047 0.026	0.342 <0.176 <0.147	1 5.5 11	-170
16. top bottom	11.6 3.33	2,330 4,710	3,680 5,050	41.0 14.9	0.016 0.057	<0.151 <0.140	1 8	+220
17.	561	24,800	46,300	1,240	0.308	3.85	1	-200
18. top middle bottom	294 41.1 12.5	16,300 12,800 24,500	26,500 14,000 13,700	978 343 155	0.168 0.117 0.058	3.10 1.06 <0.216	1 8.5 17	-90
19. top middle bottom	287 90.9 14.7	10,900 12,300 20,600	22,200 15,200 16,400	794 350 182	0.057 0.129 0.113	2.65 1.35 <0.288	1 7.5 14.75	-90

Table 42 (continued)

Station*	Parameters						Depth of Sample in Inches	REDOX m volts
	Pb	Al	Fe	Zn	Hg	Cd		
20. top bottom	262 21.8	16,600 12,300	30,000 24,300	895 163	0.286 0.082	2.9 0.397	1 9.5	-100
21. top bottom	43.1 7.39	2,910 7,660	10,600 6,350	124 65.0	0.027 0.029	0.364 <0.172	1 7.5	-70
23. top bottom	95.3 31.8	15,100 13,500	26,800 21,100	274 145	0.177 0.142	1.51 1.30	1 3.5	
24. top bottom	134 16.3	6,250 25,400	16,400 5,840	304 66.1	0.130 0.057	1.03 0.231	1 6.5	-80
25. top middle bottom	345 17.8 5.50	20,300 4,590 3,950	23,700 8,500 6,040	821 78.9 55.0	0.110 0.164 0.226	4.69 0.811 <0.722	1 5.5 11.5	
26. top middle bottom	445 62.4 8.81	33,300 30,200 35,200	50,600 19,500 13,300	2,010 440 130	0.913 0.183 0.151	20.1 1.63 0.927	1 6.5 13	
28. top middle bottom	352 60.4 9.88	50,000 24,900 29,100	23,200 14,500 16,100	1,080 322 146	0.316 0.051 0.213	3.41 1.57 1.08	1 6.5 13.25	
29. top middle bottom	506 123 17.0	25,100 20,900 26,200	56,700 30,500 17,600	619 427 119	0.113 0.146 0.130	2.51 1.58 1.17	1 5.5 11.25	-140
30. top middle bottom	237 17.3 14.5	11,600 29,800 16,600	24,500 10,600 16,800	8,430 137 131	0.074 0.084 0.017	1.70 0.310 1.86	1 6.5 12.5	-190
31&32 top middle bottom	400 29.5 13.7	12,500 5,830 9,080	21,800 13,500 13,400	984 68.3 36.0	0.422 0.360 0.338	8.08 1.06 1.15	1 10.5 20	-50

Table 42 (continued)

Station*	Parameters					Depth of Sample in Inches	REDOX m volts
	Pb	Al	Fe	Zn	Hg		
33. top middle bottom	45.7	15,700	23,800	833	0.138	1	
	22.9	4,410	10,900	90.2	0.245	5.5	
	18.1	2,940	4,380	77.6	0.184	11.25	
34. top bottom	600	37,800	26,000	1,410	0.340	1	-45
	68.9		10,000	183	0.229	8	
35. top bottom	1,100	17,100	35,300	1,680	0.847	1	-85
	1,220	16,600	35,900	2,450	1.19	8.5	

*Stations 7, 22, 27, and 31/32 treated separately for EP toxicity and bulk analysis of metals and pesticides.

Table 43
GRAIN SIZE ANALYSIS OF
COMPOSITE SEDIMENT CORES

<u>Sediment Fraction</u>	<u>Station No.</u>			
	<u>7</u>	<u>22</u>	<u>27</u>	<u>31&32</u>
% sand	68.3	63.7	71.7	72.8
% silt	18.6	16.0	6.22	16.4
% clay	13.0	20.2	22.0	10.8

The concentrations of zinc and lead in urban runoff have been quantitatively related to the levels of zinc in automobile tires (an average of 0.73%) and lead in gasoline. As a result of that analysis it has been shown that the average deposition of these metals on road surfaces are 0.0030 g zinc/vehicle km and 0.0049 g lead/vehicle km (Christensen and Guinn, 1979). It would, therefore, be expected that surface runoff from these roads would have substantial levels of these metals. The high concentrations of lead and zinc in the sediments from the Landing Channel could be a result of this runoff. It would be interesting to see if the sediments from this area contain lower levels of lead in the future due to the increased use of unleaded gasoline in automobiles.

A review of Table 42 shows that at some sampling stations at which low levels of zinc and lead would be expected (those with watershed sub-basins of low density residential or forested land uses) there are relatively high concentrations of these metals. Most notably are cores from Stump Cove and from the deep water area southwest of Halsey Island. Heavy boat traffic could account for this anomaly. Also, the mixing of the water column during the breakdown of thermal stratification could bring these contaminants from other areas of the lake.

The far north end of Woodport Bay is an area which does not fit the pattern of decreasing lead and zinc concentrations with increasing depth into the sediments. The quarry operation with its resultant increase in runoff of sediment into the lake could be responsible for this phenomenon. The "clean" soil is likely serving to dilute the lead and zinc coming in by road surface runoff.

Aluminum and iron were found to be present in concentrations very much greater than those of the other measured metals. This is as expected since these metals are part of the background matrix. The trend for increasing aluminum and iron levels in the more recent sediments is

likely due to the same sort of processes such as land development with its resultant increase in surface runoff as those responsible for that trend with respect to lead and zinc.

Four sediment samples from different parts of the lake underwent EP toxicity and grain size analyses. The latter analysis is important because a great portion of the pollutorial potential of street surface contaminants is associated with the fine, silt and clay-like material (Sartor, Boyd, and Agardy, 1974). Table 43 illustrates this phenomenon. It can be seen that with only one exception an increase in silt and clay size particles from station to station parallels an increase in the lead and cadmium levels in those bulk sediments.

Cadmium, like zinc is found in the rubber of automobile tires (Owe, Craul, Halverson, 1982) and thus is carried into the lake with road surface runoff. The deterioration of galvanized pipe is another source of cadmium in the environment (Standard Methods, 15th ed.). Again an increase in land development and automobile traffic has likely led to the observed increase in cadmium concentrations in the upper strata of lake sediments.

Detectable levels of mercury were found in three of the four sediment samples analyzed for that metal. The source of mercury in street surface contaminants has not been identified (Sartor and Boyd, 1972), but mercury is released into the atmosphere from burning of fossil fuels and from its use as a fungicide and germicide (O'Connor and Stanford, 1979).

Both phenol and chromium were detected in all four of the sediments analyzed for those contaminants. Road surface runoff again is believed

to be their source as oils and tars contain phenol (Standard Methods, 15th ed.) and chromium is used to plate automobile bumpers and trim (Sartor and Boyd, 1972).

No cyanide was found in any of the sediment samples. This is not surprising since the persistence of cyanide in water is variable. It is decomposed by microorganisms in both anaerobic and aerobic environments (O'Connor and Stanford, 1979).

Endrin and toxaphene, two components of pesticides, were detected in two and one core samples, respectively. Spray application of these chemicals by governmental agencies and/or homeowners in the Crescent Cove and Point Pleasant areas of the lake is suspected to be their means of release into those watershed sub-basins.

No herbicides were found to be present in any of the core samples tested for those contaminants.

Table 44 contains the results of the analysis on the extract from the four cores that underwent EP toxicity analysis. It is evident that no significant amount of leaching of contaminants from the sediment took place under the acid conditions (pH 5.0) of the extraction procedure. This result is significant when dealing with a New Jersey lake where acid-precipitation is prevalent.

Table 44

METALS AND PESTICIDES ANALYSIS OF
COMPOSITE SEDIMENT CORES

	Bulk Analysis				EP Toxicity Elutriate			
	Station No.				Station No.			
	7	22	27	31&32	7	22	27	31&32
*Mercury	0.136	0.114	<0.040	0.202	<0.00007	<0.00007	0.027	<0.00007
*Lead	236	545	165	131	0.009	0.026	0.007	<0.005
*Cadmium	4.44	8.41	9.52	3.45	<0.001	0.003	0.002	<0.001
*Phenol	2.88	0.667	0.360	0.908	<0.007	0.008	0.021	<0.007
*Cyanide	<7.56	<6.01	<8.0	<10.1				
*Chromium	22.8	25.9	9.28	7.74	<0.008	<0.008	<0.008	0.010
**Lindane	<6.05	<4.81	<6.4	<8.07	<1.0	<1.0	<1.0	<1.0
**Endrin	<6.05	<4.81	112	258	<1.0	<1.0	<1.0	<1.0
**Toxaphene	<60.5	<48.1	<64.0	<80.7	<10.0	<10.0	<10.0	<10.0
**Methoxychlor	<6.05	<4.81	<6.40	104	<1.0	<1.0	<1.0	<1.0
**2,4,-D	<7.56	<6.01	<8.00	<10.1	<1.0	<1.0	<1.0	<1.0
**2,4,5-TP Silvex	<7.56	<6.01	<8.00	<10.1	<1.0	<1.0	<1.0	<1.0

*Bulk sample concentration in mg kg⁻¹, EP-toxicity concentration in mg l⁻¹.**Bulk sample concentration in µg kg⁻¹, EP-toxicity concentration in µg l⁻¹.